ARMY RESEARCH LABORATORY

An Investigation of Factors Affecting Multi-task Performance in an Immersive Environment

by Teresa A. Branscome and Jock O. Grynovicki

ARL-TR-4325 **December 2007**

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14. ABSTRACT

This report presents the results of a study included in a series of investigations designed to increase fundamental knowledge and understanding of the factors affecting multi-task performance in a military environment.

In this study, each of 26 civilian and military participants completed a battery of questionnaires designed to gather information about individual differences. Included were a demographics questionnaire; the Zuckerman-Kuhlman Personality Questionnaire Form III; the polychronicity scale; the Dundee Stress State Questionnaire; and the Situational Self-Efficacy scale.

The performance component took place in Tactical Environment Simulation Facility (TESF), a controlled laboratory-based research facility. Multi-task performance was evaluated with the use of the Synthetic Work Environment (SYNWORK), a computer-based environment that runs on a personal computer or a laptop (Elsmore, 1994). In addition, a visual target identification scenario was presented in the TESF on a 10- by 12.5-foot rear-projected flat wall display via the DI-Guy[1] Scenario.

All test participants performed the performance task in each of three conditions: one in which particpants performed only the SYNWORK tasks, another in which the SYNWORK memory task was eliminated and the participants were required to simultaneously identify targets on the large screen, and another that required target detection and all SYNWORK tasks.

Multivariate analyses conducted on overall task performance measures revealed significant differences between workload levels and experience, and cluster analyses showed significant differences in performance between high and low groups base on mental and physical workload ratings.

[1]DI-Guy is a trademark of Boston Dynamics.

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1. Background

The U.S. Army's Future Force will be required to perform multiple competing cognitive tasks simultaneously in information-rich environments. In those environments, Soldiers may become overloaded and may perform one or more of the tasks poorly, especially if performance of one task interferes with performance of one or more of the others. However, it is essential that Soldiers attain a state of cognitive readiness that will enable them to perform all tasks with equal success. Cognitive readiness is defined as the optimization and enhancement of human cognitive performance (Foster, 2001). It is an enhanced state of mental acuity, i.e., the ability of the Soldier to meet the expected cognitive demands of a situation.

Therefore, it is important to understand the impact and limitations of multi-tasking on human performance so that standards can be developed for optimizing Soldier performance in proposed Future Combat Systems. It is not acceptable to base those standards of measures derived from the quantification of human performance of individual tasks. Quantifying performance of a complete set of tasks is fundamentally different than quantifying performance of each task separately, and so it is necessary to measure performance in an environment that requires the completion of multiple tasks simultaneously.

The directive for this research originated from an initial request from the office of the Deputy Chief of Staff of Training at Headquarters Training and Doctrine Command, requesting the U.S. Army Research Laboratory's (ARL's) Human Research and Engineering Directorate (HRED) to provide information about the impacts of multi-tasking on human performance. The literature survey conducted within the Cognitive Sciences Branch at HRED resulted in an information paper that identified an Army need for research to be conducted to investigate individual and group differences in multi-task performance. It has been recommended that these studies include within-groups differences, measures of self-efficacy, and other resiliency measures to assist in determining the mediators of multi-task performance.

An initial investigation performed at ARL aimed at identifying predictors of multi-task performance identified neuroticism, also described as emotionality, as a good predictor of performance (Branscome, Swoboda, & Fatkin, to be published); those who scored lower on the neuroticism scale performed better. Additionally, those who had a tendency for worry, tension, and indecisiveness did not perform as well as those who scored lower on the neuroticism scale. Based on results derived from the polychronicity scale, participants who showed a preference for working on several projects at a time as opposed to working on only one task at a time performed better in the multi-tasking scenario. Those individuals also reported an inclination to complete parts of several projects every day rather than completing an entire project. This proposed research is the second in a series of planned studies aimed at identifying predictors of performance in a multi-task environment.

Research conducted by Driskell and Salas (1996) indicated that gains in predicting effective performance will come from advances in understanding personality characteristics. For example, differences on an impulsive dimension might be a factor when one is favoring speed over accuracy for dynamic tasks. Likewise, individuals who tend to perceive the multi-tasking scenario as a challenge may perform better than individuals who experience the multiple tasks as threatening or highly frustrating distractions.

Another factor of multi-task performance addresses uncertainty. In support of the command and control (C2) in the complex and urban terrain science and technology objective, ARL's Cognitive Readiness team is identifying various metrics that may be used to predict combat effectiveness in uncertain situations. Uncertainty in decision making, an inevitable component of any military operation, may be attributable to insufficient information regarding the choices or the consequences of each choice (Bar-Tal, 1994). At any given time, most of what is known is only partially understood (John, Callan, Proctor, & Holste, 2000).

> While we try to reduce these unknowns by gathering information, we must realize that we cannot eliminate them. The very nature of war makes absolute certainty impossible; all actions in war will be based on incomplete, inaccurate, or even contradictory information (United States Marine Corps, 1997).

Even though uncertainty cannot be eliminated from military operations, researchers can examine the effects of uncertainty on decision making and how these effects can be eliminated or minimized (John et al., 2000). Research by Bar-Tal and colleagues (1994) has shown that there are individual differences in how decisions are made during conditions of certainty. In uncertain situations, some Soldiers may rely on the first-derived solution or on past experiences. Others may go through a process of hypothesis generation and validation.

According to Bar-Tal (1994), there are two factors that determine how an individual will cope with uncertainty and conflictual decision making: the need for cognitive structure and the ability to achieve cognitive structure. Cognitive structuring is defined as the creation and use of abstract mental representations, such as schemas, scripts, and stereotypes, which are simplified generalizations of previous experiences (Neuberg & Newson, 1993). The need for cognitive structure (NCS) is defined as the desire for clear and firm knowledge regarding a topic as opposed to ambiguity; it is the extent to which individuals prefer to use cognitive structuring (Bar-Tal, 1994). The ability to achieve cognitive structure (AACS) is the extent to which an individual is able to avoid information that cannot be categorized or does not match their existing knowledge structure; it is the ability to organize knowledge to fit existing cognitive structures. The process of cognitive structuring facilitates certainty by screening inconsistent or irrelevant information (Fiske & Linville, 1980).

Levels of NCS and AACS affect how an individual perceives a situation and how much time is spent making the decision. For example, Bar-Tal (1994) showed that the individuals with a high NCS and low AACS preferred to use cognitive structuring but were least able to achieve certainty, and as a result, they took the longest amount of time making the decision. Individuals with high

NCS and high AACS preferred to use cognitive structuring, were able to achieve certainty, and as a result, spent the least amount of time making the decision.

Bar-Tal, Raviv, and Spitzer (1999) suggest that the NCS and AACS may moderate the effects of stress on decision making. In that study, stress was manipulated when task difficulty and cognitive load were increased. Results showed that stress decreased the difficultly of making a decision for individuals with high NCS and high AACS. However, stress increased the difficulty of making a decision for individuals with high NCS and low AACS. As stress increased, high NCS and high AACS individuals increased their use of cognitive structuring. In contrast, as stress increased, high NCS and low AACS individuals decreased their use of cognitive structuring and used more effortful information processing instead to make decisions. In general, under stress, individuals tend to use information processing strategies that are in accordance with their level of NCS and AACS. However, if stress is too high, it can be maladaptive and can prevent the use of preferred strategies.

Greco and Roger (2001) suggest that personality factors moderate an individual's response to uncertainty. According to Greco and Roger, tolerance of uncertainty has both a cognitive and emotional component. These authors developed the Uncertainty Response Scale (URS) to assess styles of coping with uncertainty. The URS assesses coping on three levels: emotional uncertainty, desire for control, and cognitive uncertainty. The cognitive uncertainty subscale of the URS is similar to NCS and AACS scales developed by Bar-Tal (1994). The URS has an emotional dimen-sion of coping not addressesd by Bar-Tal and colleagues' measures. Preliminary studies have shown that the scores on the URS are highly correlated with individual personality differences. For example, emotional uncertainty was positively correlated with neuroticism and anxiety. Desire for control was correlated with extraversion and impulsivity. Cognitive uncertainty negatively correlated with tolerance of ambiguity.

Previous literature has shown that there are individual differences in how people cope with certainty, which in turn impact performance (i.e., decision making). According to Bar-Tal and others (Bar-Tal, 1994, 1999), the NCS and the AACS are two factors that determine how individuals cope with uncertainty and conflictual decision making. Greco and Roger (2001) expand this cognitive-based coping structure by including emotional uncertainty and desire for control. In a study conducted by the Cognitive Readiness in Stressful Environments Team at the Harford County Emergency Operations Center, responses on these scales were correlated with personality traits to assess factors influencing dispatchers' styles of coping with uncertainty. Results indicated that individuals with higher neuroticism scores have difficulty in making decisions in uncertain situations (Cosenzo, Fatkin, & Branscome, 2005). One objective of the present study is to further assess the utility of Bar-Tal's and Greco and Rogers' metrics for predicting performance in a multi-task environment.

(Note: The information referenced on pp. 2 and 3 was taken from Cosenzo, Fatkin, & Branscome, 2005.)

The measurement of performance in a multi-task environment also requires the evaluation of mental workload, a concept used to describe the cost of performance of a task as a reduction in mental capacity to perform concurrent tasks (Damos, 1991). It has been shown that individual differences in temperament, such as risk-taking components, have been predictive of workload perception and preferences.

2. Objectives

This research effort was directed toward increasing fundamental knowledge and understanding of the factors affecting multi-task performance and to identify non-invasive measures of cognitive readiness in military environments. Information gathered from this study, with value added from results of previous multi-task research, will be used in subsequent research that will ultimately contribute to the development of standards for the Future Force Warrior program.

A primary objective of this laboratory experiment was to determine the effects of increased task load on multi-task performance, while simultaneously determining if any relationships exist between performance and individual differences when workload is increased. It was hypothesized that increased task loads would result in decreased performance and that significant differences in multi-task performance would be related to individual differences in personality traits (e.g., polychronicity) and would be positively correlated with performance.

3. Method

3.1 Test Participants

A total of 26 male and female civilian and military volunteers participated in this study. Participants ranged in age from 18 through 55 years and had various degrees of computer experience.

3.2 Apparatus

3.2.1 Tactical Environment Simulation Facility

This study took place in the Tactical Environment Simulation Facility (TESF), ARL's 6,000-ft^2 simulation environment. The TESF includes a reconfigurable stereoscopic display system consisting of three self-contained 10-ft by 12.5-ft rear-projected modules that can be arranged to form a flat wall display, an immersive theater, or an enclosed cave-like environment. The visual target identification scenario was presented in the TESF on a 10-ft by 12.5-ft rear-projected flat wall display with the DI-Guy[1] Scenario. This scenario is a tool used to add life-like human figures to real-time simulations.

[1] DI-Guy is a trademark of Boston Dynamics.

3.2.2 Synthetic Work Environment (SYNWORK)

Participants used SYNWORK, a computer-based synthetic work environment that runs on a personal desktop computer or a laptop (Elsmore, 1994). They were required to work simultaneously on four distinct tasks that were presented on a computer screen. The tasks (Sternberg memory, three-column addition, visual tracking, and signal discrimination) required continuous attention and involved memory, arithmetic processing, and visual and auditory monitoring.

Each SYNWORK task is presented in a separate quadrant on the screen (see figure 1). The memory task, in the upper left quadrant, consists of an initial display of a five-character alphabetic memory set that remains on the screen for the first 10 seconds of each trial. The memory set remains the same for each trial but varies across trials. After the memory set is removed from the display, a probe letter is displayed periodically. The participant must determine whether this letter is a member of the memory set and must respond “yes” or “no”.

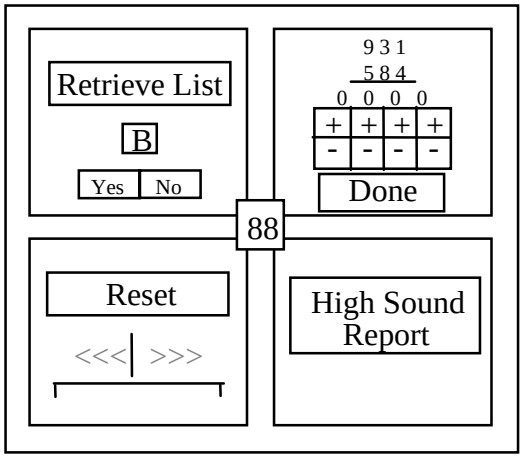


Figure 1. The SYNWORK screen.

The arithmetic task, in the upper right quadrant, is a self-paced task requiring the addition of two three-digit numbers. Participants use a mouse to adjust plus or minus buttons to achieve the correct solution.

The visual tracking task, in the lower left quadrant, requires participants to monitor the position of a vertical bar that moves along a horizontal scale. Participants use a mouse to reset the bar before it reaches one of the ends of the scale.

In the signal discrimination task, high (2092 Hz) and low tones (523 Hz) are presented periodically through headphones worn by the participants. The task requires the participants to use a mouse to respond whenever a high tone is presented.

3.2.3 Demographics Questionnaire

Participants were required to complete a demographics questionnaire (appendix A). It solicited information regarding age, gender, vision and hearing, military service, and computer experience.

3.2.4 Multiple Affect Adjective Checklist - Revised (MAACL-R)

The general form of the MAACL-R was administered (appendix B; Zuckerman & Lubin, 1985). The MAACL-R consists of five primary subscales (Anxiety, Depression, Hostility, Positive Affect, and Sensation Seeking) derived from a one-page list of 132 adjectives. An overall distress score, Dysphoria or Negative Affect, is calculated by the addition of the Anxiety, Depression, and Hostility scores. The respondents were instructed to check all the words that describe how they "generally" feel.

3.2.5 Polychronicity Scale

Participants also completed a pencil-and-paper ten-item polychronicity scale (appendix C). This scale was used to determine the extent to which individuals prefer working on several tasks at once as opposed to working on only one task at a time (Bluedorn, Kalliath, Strube, & Martin, 1999).

3.2.6 Zuckerman-Kuhlman Personality Questionnaire-Form III

The Zuckerman-Kuhlman Personality Questionnaire-Form III (ZKPQ-III, appendix D) was administered to identify five components of personality in five subscales: Activity, Aggression-Hostility, Sociability, Neuroticism-Anxiety, and Impulsive Risk Taking. This five-factor model is recommended for research involving personality correlates because it provides maximal specificity at no loss in reproducibility across gender and populations (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993). The ZKPQ-III is a 99-item, true-false inventory of temperament that was used solely as a research instrument and not as a psychiatric or clinically diagnostic tool. The information obtained from this questionnaire identifies basic dimensions of temperament proposed to correlate with various cognitive skills. Only group data are reported. The internal reliabilities on the five subscales range from 0.72 to 0.86 (O'Sullivan, Zuckerman, & Kraft, 1998; Zuckerman et al., 1993).

3.2.7 Situational Self-Efficacy

Participants completed the Situational Self-Efficacy (SSE) scale (appendix E), which was developed for investigating the predictive power of efficacy expectations about behavior or task performance (Bandura, 1977). Participants were asked to rate (from 1 to 10) their level of confidence in their ability to do well. There is extensive evidence that self-efficacy is associated

with higher levels of motivation and performance for both civilian and military populations (Fatkin & Hudgens, 1994; Potosky, 2002; Branscome et al., to be published).

3.2.8 Dundee Stress State Questionnaire (DSSQ)

The DSSQ was administered. It (appendix F; Matthews, Joyner, Gilliland, Campbell, & Huggins, 1999) is a multidimensional assessment tool for stress relevant to performance testing contexts. The DSSQ consists of four subscales: mood state, motivation, thinking style, and thinking content. Scores for three factors are derived from the subscales: task engagement, distress and worry. Additionally, one component of the DSSQ assesses participants' perceptions of their physical and mental workload. One version of the DSSQ is administered before task performance and the other is administered after task performance.

3.2.9 The Need for Cognitive Structure (NCS) Scale

The NCS Scale (appendix G; Bar-Tal, 1993) is a 20-item scale that assesses the extent of an individual's preference for using cognitive structuring.

3.2.10 The Ability to Achieve Cognitive Structure (AACS) Scale

The AACS Scale (appendix H; Bar-Tal, 1993) is a 24-item scale that assesses the extent to which individuals are able to apply information processes that are consistent with their need for cognitive structure.

3.2.11 Uncertainty Response Scale

The URS (appendix I; Greco & Roger, 2001) is a 48-item scale that was designed to predict individual differences in coping with uncertainty. The URS consists of three factors: emotional uncertainty, desire for change, and cognitive uncertainty.

3.3 Procedures

A pilot study was completed before actual testing to ensure that participants were able to discern between friendly and enemy targets in each of the three conditions.

Before testing, all individuals were briefed about the purpose and procedures of the study and were read the volunteer agreement affidavit (appendix J). No monetary incentive was offered for being in the study and participants had the option of withdrawing from the study at any time. Volunteers were given the required brief regarding confidentiality as indicated on Department of the Army Form 5303-R. However, in anticipation of possible concerns regarding personal answers on some of the questionnaires, the investigators also described the deliberate actions taken when they handled research data. In order to ensure that individual data would not be reported or revealed to anyone, each form was reviewed upon receipt by one of the investigators. If any identifying information appeared on the questionnaires (such as name, social security

number, birth date, etc.), the investigators deleted the identifying information and replaced it with a neutral code number. This code number became the participant's identification number used in data files.

When military research participants are recruited, a concern about their *actual willingness* to volunteer for a study may arise if higher ranking personnel have "suggested" that they participate. Although incidences of this method of covert coercion have decreased in recent years, investigators need to address the possibility. In this study, potential volunteers were reminded that they could refuse or later withdraw from the study without penalty. As in previous studies, individuals were given an opportunity to communicate their desires to the investigators "off the record" and were provided several options for refusing or withdrawing in a private manner.

Those who agreed to participate signed the volunteer agreement affidavit. Then they completed the Demographics Questionnaire, the MACCL-R (Zuckerman & Lubin, 1985), the ZKPQIII (Zuckerman et al., 1993), the polychronicity scale (Bluedorn et al., 1999), the DSSQ (Matthews et al., 1999), the NCS scale (Bar-Tal, 1994), the AACS scale (Bar-Tal, 1994), and the URS (Greco & Rogers, 2001) before the study began. These questionnaires are designed to tap different dimensions of personality that are believed to be predictors of performance in a multi-task environment.

All test participants performed the performance task in each of three conditions. The three conditions were counterbalanced to minimize learning and order effects (appendix I). In condition A, participants performed all SYNWORK tasks simultaneously. The scenario was displayed on the large screen, but no additional task was required. In condition B, the SYNWORK memory task was eliminated and the participants were required to identify friendly or enemy targets as they appeared on the large screen by stating "friend" or "enemy". The test administrator recorded the response at each presentation of a target and noted if it was a correct, incorrect, or missed target. Condition C required the detection of friendly and enemy targets in addition to all four SYNWORK tasks. Participants were not given any instructions concerning priority of the four tasks. They were instructed to complete each task as quickly and as accurately as possible without priority.

During the training phase, participants completed two 5-minute practice sessions in each condition. Eight friendly and eight enemy targets appeared on the screen randomly at one of eight different locations and remained on the screen for 5 seconds. In each test scenario, 16 friendly and 16 enemy targets were presented randomly and at random time intervals. Friendly targets were identified as those dressed in desert battle dress uniforms and enemy targets appeared as European Soldiers (see figure 2). Test sessions lasted 10 minutes.

Volunteers were seated 11 feet from the screen displaying the DI-Guy scenario. The SYNWORK screen was raised 4 feet from the ground. Each participant was provided with a set of headphones for the audio portion of SYNWORK, and background environmental noise was emitted throughout testing.

Figure 2. Friendly and enemy targets at all possible locations.

4. Experimental Design

This study is a single-factor, randomized, within-subjects design. All volunteers participated in each test condition.

4.1 Independent Variables

Independent variables were

Task difficulty level (A = SYNWORK only
B = SYNWORK without memory task + target identification
C = SYNWORK + target identification)

4.2 Dependent Variables

- Overall SYNWORK task scores
- Number of enemy and friendly targets correctly identified

5. Results

Throughout the data collection period, some data points were lost because of equipment malfunction or operator error. This resulted in a few unequal N's (numbers of subjects) across groups but did not result in reduced significance in the reported findings.

6. Performance Data

The sums of the addition, visual tracking, and signal discrimination tasks were used as the performance measure for data analysis since each participant performed all those tasks in every condition.

6.1 Workload Level

One of our primary hypotheses was that as workload increased, performance would decrease. A repeated measures analysis of variance (ANOVA) was used to examine differences in the combined SYNWORK scores (arithmetic, visual tracking, and signal discrimination) to assess performance across workload levels. A .05 criterion level for significance was employed throughout the analyses. Results revealed a significant within-subjects effect, Wilks' $\lambda = 525$; F (2,21) = 10.498; p = .001). Participants scored significantly lower in Condition C (Workload level 3) than they did in both conditions A (Workload level 1) (F (1,21) = 4.592; p = .00) and B (Workload level 2) (F (1,21) = 3.463; p = .02) (see figure 3).

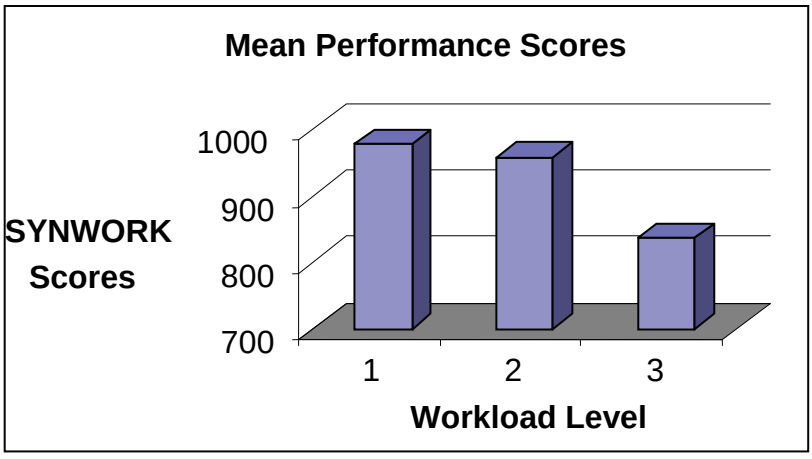


Figure 3. Performance Scores x Workload Level interaction.

6.2 Experience

The effect of experience with the scenario was investigated with a repeated measures ANOVA on performance over trial. Results revealed a significant difference between Trial 1 and Trial 3, ($F(2,21) = 11.209$; $p = .003$), which suggested that regardless of the amount of workload, participants' scores increased over trials (see figure 4).

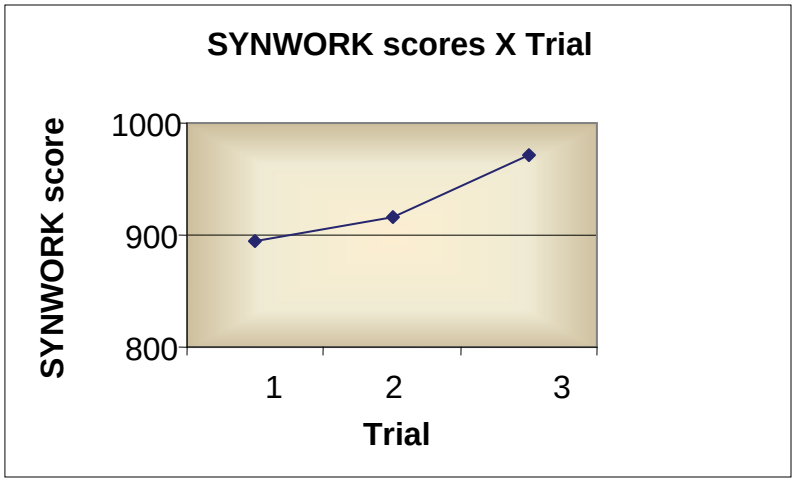


Figure 4. SYNWORK scores by trial.

7. Individual Characteristics

7.1 Workload (mental, physical)

Spearman's rank order correlations were computed to determine the relationship between the subject's mental and physical perceived workload (as reported in the DSSQ) and the mean SYNWORK performance scores. The subjects' perceived mental workload scores showed a significant positive correlation with mean SYNWORK performance scores ($r(23) = .56$; $p = .01$), indicating that performance increased as mental workload increased. Physical workload scores also showed a significant positive correlation with mean SYNWORK performance scores (r (23) = .53; $p = .01$). The data suggest that as the subject's perceived mental and physical workload increased, so did his or her performance.

Cluster analysis was used to examine the effect of individual differences on the performance outcome. Cluster analysis is a method of statistically identifying homogeneous groups of individuals based on similar characteristics. This analysis of the subject's mental workload scores revealed two distinct groups of individuals with high and low levels of perceived mental workload. The high mental workload group rated themselves as having workload ratings of 3.3 and a mean SYNWORK score of 1032. The lower group had a perceived mental workload score of 2 and

obtained a mean score of 870. The F statistic was significant (F (1, 21) = 4.32; p < =.05), which revealed a significant difference in performance between the two groups. This suggests that mental workload could provide a critical contribution to the evaluation of multi-task performance.

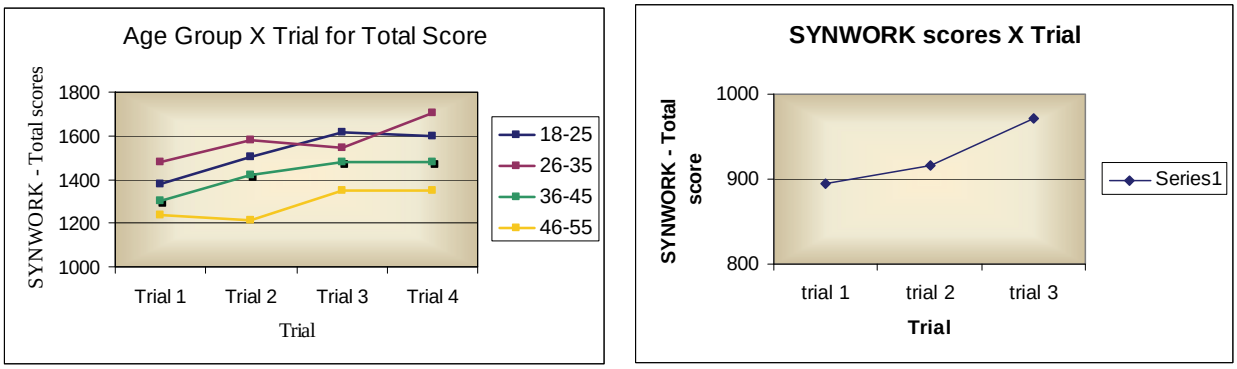
Similarly, perceived physical workload analysis demonstrated a similar trend. Cluster analysis of the subject's physical workload scores revealed two distinct groups of individuals with high and low levels of perceived physical workload. The high physical workload group rated themselves as having workload ratings of 4.0 and a mean SYNWORK score of 1111. The lower group had a perceived physical workload score of 2.5 and obtained a mean score of 882. The F statistic was significant (F (1, 21) = 9.81; p < =.01), which revealed a significant difference in performance between the two groups. This suggests that individuals who reported high physical workload performed significantly better at multi-task monitoring than those who reported lower levels.

8. Discussion

One of the objectives of this research, as well as the initial multi-task research study performed at ARL, was to increase our fundamental knowledge and understanding of the factors affecting multi-task performance and to identify non-invasive measures of cognitive readiness in military environments. Results from the initial study (Branscome et al.) led us to believe that polychronicity may be a good predictor of performance in multi-task environments, so it was included as part of the cognitive battery in this study. However, we found no consistent significant correlations between polychronicity and performance in this study. Other researchers (König, Bühner, & Mürling, 2005; Ishizaka, Marshall, & Conte, 2001) who have performed research in this area found similar results. Although individuals may report polychronic preferences, they may not perform well in multi-task environments. They may like the complexity, challenge, and constant change of the multi-task scenario but are not able to accurately judge their own ability in those environments. Additionally, no correlation was found between polychronicity and the Situational Self-efficacy scale, which implied that although individuals may have reported feeling confident in their ability to perform this task well, there was no parallel between their performance and their preferences for working on multiple tasks. We attribute these findings to lessons learned and therefore will not incorporate the polychronicity questionnaire into future studies associated with this line of research.

When the effect of experience with the scenario was investigated in this study, the results revealed a trend in performance similar to that found in the first multi-task research study performed at ARL (Branscome et al.). Regardless of the level of performance initially, participants' performance improved with practice (see figure 5). Future research is planned to determine if all individuals can achieve the same asymptote of performance, regardless of their initial performance, and the amount

of training or practice that is required for everyone to reach that same asymptote. This will have important implications for training and selection of personnel in C2 environments.



Multi-task Performance Study I
average scores over trials

Multi-task Performance Study II
average scores over trials

Figure 5. Comparison of results between multi-task studies.

The significant differences between performance in the high and low groups of perceived mental workload lead us to the conclusion that those who believed they had high levels of workload performed better. However, when an individual is overloaded with task demands, it is likely that performance will decrease. Instinctively, it would seem logical to lessen an operator's mental workload by reducing the number or the complexity of certain tasks. However, it is essential to optimize workload to achieve optimal performance. A lack of challenging cognitive demands can result in mental underload, which can be as detrimental to performance as overload. Therefore, additional research in this area will be performed in simulated C2 environments to determine individual thresholds of workload, and the implications of mental over- and underload.

The use of SYNWORK as a computer-simulated multi-task environment is sufficiently complex and has been a valid means for the assessment of basic factors affecting performance in a laboratory setting at ARL. This tool will be used in future research efforts to determine strategies that individuals employ while performing cognitively competing tasks. Information gained and lessons learned from that research, as well as the basic multi-task studies performed at ARL, will be incorporated into further endeavors that will examine the allocation of Soldier resources for enhanced performance of C2 tasks in a simulated tactical operations center environment.

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Appendix A. Demographic and Computer Experience Questionnaire

Demographic and Computer Experience Questionnaire

1. AGE: _____

2. GENDER: ___Male ___ Female

3. Do you wear glasses? ___ Yes ___ No

4. Is your vision corrected to 20/20 with eyeglasses or contacts? ___Yes ___ No

5. Do you have an apparent hearing impairment? ___Yes ___No

6. Please indicate your highest level of education:
   ___ High School Diploma
   ___ Undergraduate Degree
   ___ Some graduate courses
   ___ Graduate Degree
   ___ Other

7. Are you in the Army? ___Yes ___No

   If yes, for how many years? ___Less than 5 years ___5-10 years ___ 11-15 years ___16-20 years ___ 20 years or more

   What is your rank? _____ What is your MOS? _____

8. Does your job require you to use a computer on a regular basis? ___Yes ___No

9. How long have you been using a computer?

__Less than 1 year ___ 1-3 years ___4-6 years ___7-10 years ___10 years or more

10. How often do you use a computer?

___Daily ___Weekly ___Monthly ___Once or twice a year

10. Do you have a computer in your house? ___Yes ___No

11. Do you use the computer to play games? ___Yes ___No

    If yes, how often? ___Daily ___Weekly ___Monthly ___Once or twice a year

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Appendix B. Multiple Affect Adjective CheckList – Revised

	A PA	D SS	H
1 ☐ active	45 ☐ fit		89 ☐ peaceful
2 ☐ adventurous	46 ☐ forlorn		90 ☐ pleased
3 ☐ affectionate	47 ☐ frank		91 ☐ pleasant
4 ☐ afraid	48 ☐ free		92 ☐ polite
5 ☐ agitated	49 ☐ friendly		93 ☐ powerful
6 ☐ agreeable	50 ☐ frighten		94 ☐ quiet
7 ☐ aggressive	51 ☐ fur		95 ☐ reckless
8 ☐ alive	52 ☐ lively		96 ☐ rejected
9 ☐ alone	53		97 ☐ rough
10 ☐ amiable	54 ☐ lad		98 ☐ sad
11 ☐ amused	55 ☐ my		☐ saf
12 ☐ angry	56 ☐ good		100 ☐ satisfied
13 ☐ annoyed	☐ good-natured		101 ☐ secure
14 ☐ awful	☐ grim		☐ shaky
15 ☐ bashful	☐ ppy		☐ shy
16 ☐ bitter	60 ☐ healthy		104 ☐ soothed
17 ☐ blue	☐ hopeless		☐ steady
18 ☐ bored	62 ☐ hostile		☐ stubborn
19 ☐ ca	63 ☐ impatient		107 ☐ stormy
20 ☐ caut	64 ☐ incense		108 ☐ strong
☐ heerful	65 ☐ indignant		109 ☐ suffering
22 ☐	66 ☐ inspired		110 ☐ sullen
☐	67 ☐ interested		111 ☐ sunk
☐ con d	☐ irrita		112 ☐ sympathetic
☐ ntra	☐ jealous		113 ☐ tame
26 ☐	70 ☐ joyful		114 ☐ tender
27 ☐ ooperative	☐ kindl		115 ☐ tense
28 ☐ critical	☐ lonely		116 ☐ terrible
29 ☐ cross	73 ☐ lost		117 ☐ terrified
30 ☐ cruel	74 ☐ loving		118 ☐ thoughtful
31 ☐ daring	☐ low		119 ☐ timid
32 ☐ desperate	76 ☐ lucky		120 ☐ tormented
33 ☐ destroyed	77 ☐ mad		121 ☐ understanding
34 ☐ devoted	78 ☐ mean		122 ☐ unhappy
35 ☐ disagreeable	79 ☐ meek		123 ☐ unsociable
36 ☐ discontented	80 ☐ merry		124 ☐ upset
37 ☐ discouraged	81 ☐ mild		125 ☐ vexed
38 ☐ disgusted	82 ☐ miserable		126 ☐ warm
39 ☐ displeased	83 ☐ nervous		127 ☐ whole
40 ☐ energetic	84 ☐ obliging		128 ☐ wild
41 ☐ enraged	85 ☐ offended		129 ☐ willful
42 ☐ enthusiastic	86 ☐ outraged		130 ☐ wilted
43 ☐ fearful	87 ☐ panicky		131 ☐ worrying
44 ☐ fine	88 ☐ patient		132 ☐ young

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Appendix C. Polychronicity Scale

Directions: Please circle one rating for each statement that reflects how you feel.

(1) I like to juggle several activities at the same time.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(2) I would rather complete an entire project every day than complete parts of several projects.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(3) I believe people should try to do many things at once.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(4) When I work by myself, I usually work on one project at a time.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(5) I prefer to do one thing at a time.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(6) I believe people do their best work when they have many tasks to complete.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(7) I believe it is best to complete one task before beginning another.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(8) I believe it is best for people to be given several tasks and assignments to perform.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(9) I seldom like to work on more than a single task or assignment at the same time.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(10) I would rather complete parts of several projects every day than complete an entire project.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Appendix D. Zuckerman-Kuhlman Personality Questionnaire - Form III (ZKPQ-III)

DIRECTIONS: On the following pages you will find a series of statements that persons might use to describe themselves. Read each statement and decide whether or not it describes you. Then mark each statement as either True (T) if you agree with the statement or if it describes you, or False (F) if you disagree with the statement or if it does not describe you. Answer every statement even if you are not entirely sure of your answer.

____ 1. I tend to begin a new job without much advance planning on how I will do it.

____ 2. I do not worry about unimportant things.

____ 3. I enjoy seeing someone I don't care for humiliated before other people.

____ 4. I never met a person that I didn't like.

____ 5. I do not like to waste time just sitting around and relaxing.

____ 6. I usually think about what I am going to do before doing it.

____ 7. I am not very confident about myself or my abilities.

____ 8. When I get mad, I say ugly things.

____ 9. I tend to start conversations at parties.

____ 10. I have always told the truth.

____ 11. It's natural for me to curse when I am mad.

____ 12. I do not mind going out alone and usually prefer it to being out in a large group.

____ 13. I lead a busier life than most people.

____ 14. I often do things on impulses.

____ 15. I often feel restless for no apparent reason.

____ 16. I almost never litter the streets with wrappers.

____ 17. I would not mind being alone in a place for some days without any human contacts.

____ 18. I like complicated jobs that require a lot of effort and concentration.

____ 19. I very seldom spend much time on the details of planning ahead.

____ 20. I sometimes feel edgy and tense.

____ 21. I almost never feel like I would like to punch or slap someone.

____ 22. I spend as much time with my friends as I can.

____ 23. I do not have a great deal of energy for life's more demanding tasks.

____ 24. I like to have new and exciting experiences and sensations even if they are a little frightening.

____ 25. My body often feels all tightened up for no apparent reason.

____ 26. I always win at games.

____ 27. I often find myself being "the life of the party."

____ 28. I like a challenging task much more than a routine one.

____ 29. Before I begin a complicated job, I make careful plans.

____ 30. I frequently get emotionally upset.

____ 31. If someone offends me, I just try not to think about it.

____ 32. I have never been bored.

____ 33. I like to be doing things all of the time.

____ 34. I would like to take off on a trip with no preplanned or definite routes or timetable.

____ 35. I tend to be oversensitive and easily hurt by thoughtless remarks and actions of others.

____ 36. In many stores you just cannot get served unless you push yourself in front of other people.

____ 37. I do not need a large number of casual friends.

____ 38. I can enjoy myself just lying around and not doing anything active.

____ 39. I enjoy getting into new situations where you can't predict how things will turn out.

____ 40. I never get lost, even in unfamiliar places.

____ 41. I am easily frightened.

____ 42. If people annoy me I do not hesitate to tell them so.

____ 43. I tend to be uncomfortable at big parties.

____ 44. I do not feel the need to be doing things all of the time.

____ 45. I like doing things just for the thrill of it.

____ 46. I sometimes feel panicky.

____ 47. When I am angry with people I do not try to hide it from them.

____ 48. At parties, I enjoy mingling with many people whether I already know them or not.

____ 49. I would like a job that provided a maximum of leisure time.

____ 50. I tend to change interests frequently.

____ 51. I often think people I meet are better than I am.

____ 52. I never get annoyed when people cut ahead of me in line.

____ 53. I tend to start my social weekends on Thursday evenings.

____ 54. I usually seem to be in a hurry.

____ 55. I sometimes like to do things that are a little frightening.

____ 56. Sometimes when emotionally upset I suddenly feel as if my legs are unsteady.

____ 57. I generally do not use strong words even when I am angry.

____ 58. I would rather "hang out" with friends rather than work on something by myself.

____ 59. When on vacation I like to engage in active sports rather than just lie around.

____ 60. I'll try anything once.

____ 61. I often feel unsure of myself.

____ 62. I can easily forgive people who have insulted me or hurt my feelings.

____ 63. I would not mind being socially isolated in some place for some period of time.

____ 64. I like to wear myself out with hard work or exercise.

____ 65. I would like the kind of life where one is on the move and traveling a lot, with lots of change and excitement.

____ 66. I often worry about things that other people think are unimportant.

____ 67. When people disagree with me I cannot help getting into an argument with them.

____ 68. Generally, I like to be alone so I can do things I want to do without social distractions.

____ 69. I never have any trouble understanding anything I read the first time I read it.

____ 70. I sometimes do "crazy" things just for fun.

____ 71. I often have trouble trying to make choices.

____ 72. I have a very strong temper.

____ 73. I have never lost anything.

____ 74. I like to be active as soon as I wake up in the morning.

____ 75. I like to explore a strange city or section of town by myself, even if it means getting lost.

____ 76. My muscles are so tense that I feel tired much of the time.

____ 77. I can't help being a little rude to people I do not like.

____ 78. I am a very sociable person.

____ 79. I prefer friends who are excitingly unpredictable.

____ 80. I often feel like crying sometimes without a reason.

____ 81. No matter how hot or cold it gets, I am always quite comfortable.

____ 82. I need to feel that I am a vital part of a group.

____ 83. I like to keep busy all the time.

____ 84. I often get so carried away by new and exciting things and ideas that I never think of possible complications.

____ 85. I don't let a lot of trivial things irritate me.

____ 86. I am always patient with others even when they are irritating.

____ 87. I usually prefer to do things alone.

____ 88. I can enjoy routine activities that do not require much concentration or effort.

____ 89. I am an impulsive person.

____ 90. I often feel uncomfortable and ill at ease for no real reason.

____ 91. I often quarrel with others.

____ 92. I probably spend more time than I should socializing with friends.

____ 93. It doesn't bother me if someone takes advantage of me.

____ 94. When I do things, I do them with lots of energy.

____ 95. I like "wild" uninhibited parties.

____ 96. After buying something I often worry about having made the wrong choice.

____ 97. When people shout at me, I shout back.

____ 98. I have more friends than most people do.

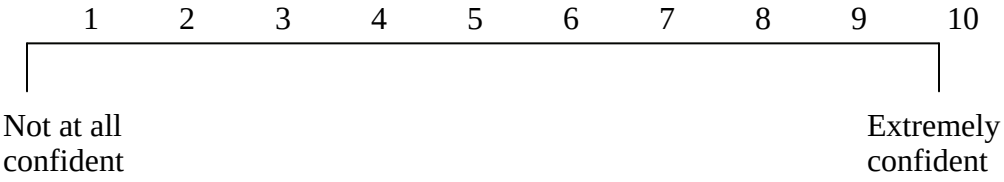
____ 99. Other people often urge me to "take it easy."

END OF THIS FORM - THANK YOU

Appendix E. Situational Self-Efficacy (SSE) Scale

On a scale from 1 to 10, how confident are you in your ability to deal with today's experiences?

Please circle one of the numbers below:



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Appendix F. Dundee Stress State Questionnaire (DSSQ)

DSSQ - PRE TASK

General Instructions. This questionnaire is concerned with your feelings and thoughts at the moment. We would like to build up a detailed picture of your current state of mind, so there are quite a few questions, divided into four sections. Please answer **every** question, even if you find it difficult. Answer, as honestly as you can, what is true of **you**. Please do not choose a reply just because it seems like the 'right thing to say'. Your answers will be kept entirely confidential. Also, be sure to answer according to how you feel **AT THE MOMENT**. Don't just put down how you usually feel. You should try and work quite quickly: there is no need to think very hard about the answers. The first answer you think of is usually the best.

Before you start, please provide some general information about yourself.

Age..... (years) Sex. M F (Circle one)
Occupation.....
If student, state your course.....
Date today..... Time of day now.....

1. MOOD STATE

First, there is a list of words which describe people's moods or feelings. Please indicate how well each word describes how you felt **AT THE MOMENT**. For each word, circle the answer from 1 to 4 which best describes your mood.

	Definitely	Slightly	Slightly Not	Definitely Not
1. Happy	1	2	3	4
2. Dissatisfied	1	2	3	4
3. Energetic	1	2	3	4
4. Relaxed	1	2	3	4
5. Alert	1	2	3	4
6. Nervous	1	2	3	4
7. Passive	1	2	3	4
8. Cheerful	1	2	3	4
9. Tense	1	2	3	4
10. Jittery	1	2	3	4
11. Sluggish	1	2	3	4
12. Sorry	1	2	3	4
13. Composed	1	2	3	4
14. Depressed	1	2	3	4
15. Restful	1	2	3	4
16. Vigorous	1	2	3	4

17. Anxious	1	2	3	4
18. Satisfied	1	2	3	4
19. Unenterprising	1	2	3	4
20. Sad	1	2	3	4
21. Calm	1	2	3	4
22. Active	1	2	3	4
23. Contented	1	2	3	4
24. Tired	1	2	3	4
25. Impatient	1	2	3	4
26. Annoyed	1	2	3	4
27. Angry	1	2	3	4
28. Irritated	1	2	3	4
29. Grouchy	1	2	3	4

2. MOTIVATION

Please answer the following questions about your attitude to the task you are about to do. For each question, circle a number from 0 to 9, according to how strongly you agree with one or other of the two extreme alternatives.

1. How motivated are you to do the task?

Not at all									Very much
0	1	2	3	4	5	6	7	8	9

2. Do you think the content of the task is:

Very dull									Very interesting
0	1	2	3	4	5	6	7	8	9

3. How eager are you to do well at the task?

Very eager									Not at all eager
0	1	2	3	4	5	6	7	8	9

4. How do you expect to feel after doing the task?

More cooperative									More annoyed
0	1	2	3	4	5	6	7	8	9

5. How much mental effort will you exert?

Very little									A great deal
0	1	2	3	4	5	6	7	8	9

6. I want to succeed on this task:

Very much									Very little
0	1	2	3	4	5	6	7	8	9

7. How will you feel if you perform badly on this task?

Very unconcerned									Very upset
0	1	2	3	4	5	6	7	8	9

8. I think that doing this task will be:

Very worthwhile									A waste of time
0	1	2	3	4	5	6	7	8	9

3. THINKING STYLE

In this section, we are concerned with your thoughts about yourself: how your mind is working, how confident you feel, and how well you expect to perform on the task. Below are some statements which may describe your style of thought **RIGHT NOW**. Read each one carefully and indicate how true each statement is of your thoughts **AT THE MOMENT**. To answer, circle one of the following answers:

Extremely = 4 Very much = 3 Somewhat = 2 A little bit = 1 Not at all = 0

1.	I'm trying to figure myself out.	0 1 2 3 4
2.	I'm very aware of myself.	0 1 2 3 4
3.	I'm reflecting about myself.	0 1 2 3 4
4.	I'm daydreaming about myself.	0 1 2 3 4
5.	I'm thinking deeply about myself.	0 1 2 3 4
6.	I'm attending to my inner feelings.	0 1 2 3 4
7.	I'm examining my motives.	0 1 2 3 4
8.	I feel that I'm off somewhere watching myself.	0 1 2 3 4
9.	I feel confident about my abilities.	0 1 2 3 4
10.	I am worried about whether I am regarded as a success or failure.	0 1 2 3 4
11.	I feel self-conscious.	0 1 2 3 4
12.	I feel as smart as others.	0 1 2 3 4
13.	I am worried about what other people think of me.	0 1 2 3 4
14.	I feel confident that I understand things.	0 1 2 3 4
15.	I feel inferior to others at this moment.	0 1 2 3 4
16.	I feel concerned about the impression I am making.	0 1 2 3 4
17.	I feel that I have less scholastic ability right now than others.	0 1 2 3 4
18.	I am worried about looking foolish.	0 1 2 3 4
19.	My attention is directed towards things other than the task.	0 1 2 3 4
20.	I am finding physical sensations such as muscular tension distracting.	0 1 2 3 4
21.	I expect my performance will be impaired by thoughts irrelevant to the task.	0 1 2 3 4
22.	I have too much to think about to be able to concentrate on the task.	0 1 2 3 4
23.	My thinking is generally clear and sharp.	0 1 2 3 4
24.	I will find it hard to maintain my concentration for more than a short time.	0 1 2 3 4
25.	My mind is wandering a great deal.	0 1 2 3 4
26.	My thoughts are confused and difficult to control.	0 1 2 3 4
27.	I expect to perform proficiently on this task.	0 1 2 3 4
28.	Generally, I feel in control of things.	0 1 2 3 4

4. THINKING CONTENT

This set of questions concerns the kinds of thoughts that go through people's heads at particular times, for example while they are doing some task or activity. Below is a list of thoughts, some of which you might have had recently. Please indicate roughly how often you had each thought **DURING THE LAST TEN MINUTES** or so, by circling a number from the list below.

1= Never 2= Once 3= A few times 4= Often 5= Very often

1.	I thought about how I should work more carefully.	1 2 3 4 5
2.	I thought about how much time I had left.	1 2 3 4 5
3.	I thought about how others have done on this task.	1 2 3 4
4.	I thought about the difficulty of the problems.	1 2 3 4 5
5.	I thought about my level of ability.	1 2 3 4 5
6.	I thought about the purpose of the experiment.	1 2 3 4 5
7.	I thought about how I would feel if I were told how I performed.	1 2 3 4 5
8.	I thought about how often I get confused.	1 2 3 4 5
9.	I thought about members of my family.	1 2 3 4 5
10.	I thought about something that made me feel guilty.	1 2 3 4 5
11.	I thought about personal worries.	1 2 3 4 5
12.	I thought about something that made me feel angry.	1 2 3 4 5
13.	I thought about something that happened earlier today.	1 2 3 4 5
14.	I thought about something that happened in the recent past (last few days, but not today).	1 2 3 4 5
15.	I thought about something that happened in the distant past	1 2 3 4 5
16.	I thought about something that might happen in the future.	1 2 3 4 5

DSSQ - POST TASK - General Instructions

This questionnaire is concerned with your feelings and thoughts while you were performing the task. We would like to build up a detailed picture of your current state of mind, so there are quite a few questions, divided into four sections. Please answer every question, even if you find it difficult. Answer, as honestly as you can, what is true of you. Please do not choose a reply just because it seems like the 'right thing to say'. Your answers will be kept entirely confidential. Also, be sure to answer according to how you felt **WHILE PERFORMING THE TASK**. Don't just put down how you usually feel. You should try and work quite quickly: there is no need to think very hard about the answers. The first answer you think of is usually the best.

1. MOOD STATE

First, there is a list of words which describe people's moods or feelings. Please indicate how well each word describes how you felt **WHILE PERFORMING THE TASK**. For each word, circle the answer from 1 to 4 which best describes your mood.

	Definitely	Slightly	Slightly Not	Definitely Not
1. Happy	1	2	3	4
2. Dissatisfied	1	2	3	4
3. Energetic	1	2	3	4
4. Relaxed	1	2	3	4
5. Alert	1	2	3	4
6. Nervous	1	2	3	4
7. Passive	1	2	3	4
8. Cheerful	1	2	3	4
9. Tense	1	2	3	4
10. Jittery	1	2	3	4
11. Sluggish	1	2	3	4
12. Sorry	1	2	3	4
13. Composed	1	2	3	4
14. Depressed	1	2	3	4
15. Restful	1	2	3	4
16. Vigorous	1	2	3	4
17. Anxious	1	2	3	4
18. Satisfied	1	2	3	4
19. Unenterprising	1	2	3	4
20. Sad	1	2	3	4
21. Calm	1	2	3	4
22. Active	1	2	3	4
23. Contented	1	2	3	4
24. Tired	1	2	3	4
25. Impatient	1	2	3	4
26. Annoyed	1	2	3	4
27. Angry	1	2	3	4
28. Irritated	1	2	3	4
29. Grouchy	1	2	3	4

2. MOTIVATION AND WORKLOAD

Please answer the following questions about your attitude to the task you have just done. For each question, circle a number from 0 to 9, according to how strongly you agree with one or other of the two extreme alternatives.

1. How motivated were you to do the task?

Not at all 0 1 2 3 4 5 6 7 8 9 Very much

2. Do you think the content of the task was:

Very dull 0 1 2 3 4 5 6 7 8 9 Very interesting

3. How eager were you to do well at the task?

Very eager 0 1 2 3 4 5 6 7 8 9 Not at all eager

4. How do you feel after doing the task?

More cooperative 0 1 2 3 4 5 6 7 8 9 More annoyed

5. How much mental effort did you exert?

Very little 0 1 2 3 4 5 6 7 8 9 A great deal

6. I wanted to succeed on this task:

Very much 0 1 2 3 4 5 6 7 8 9 Very little

7. How would you feel if you performed badly on this task?

Very unconcerned 0 1 2 3 4 5 6 7 8 9 Very upset

8. I think that doing this task was:

Very worthwhile 0 1 2 3 4 5 6 7 8 9 A waste of time

9. Please rate the MENTAL DEMAND of the task: How much mental and perceptual activity was required?

Low 0 1 2 3 4 5 6 7 8 9 10 High

10. Please rate the PHYSICAL DEMAND of the task: How much physical activity was required?

Low 0 1 2 3 4 5 6 7 8 9 10 High

11. Please rate the TEMPORAL DEMAND of the task: How much time pressure did you feel due to the pace at which the task elements occurred?

Low 0 1 2 3 4 5 6 7 8 9 10 High

12. Please rate your PERFORMANCE: How successful do you think you were in accomplishing the goals of the task?

Low 0 1 2 3 4 5 6 7 8 9 10 High

13. Please rate your EFFORT: How hard did you have to work (mentally and physically) to accomplish your level of performance?

Low 0 1 2 3 4 5 6 7 8 9 10 High

14. Please rate your FRUSTRATION: How discouraged, irritated, stressed and annoyed did you feel during the task?

Low 0 1 2 3 4 5 6 7 8 9 10 High

3. THINKING STYLE

In this section, we are concerned with your thoughts about yourself: how your mind is working, how confident you feel, and how well you believed you performed on the task. Below are some statements which may describe your style of thought during task performance. Read each one carefully and indicate how true each statement was of your thoughts **WHILE PERFORMING THE TASK**. To answer circle one of the following answers:

Extremely = 4 Very much = 3 Somewhat = 2 A little bit = 1 Not at all = 0

1.	I tried to figure myself out.	0 1 2 3 4
2.	I was very aware of myself.	0 1 2 3 4
3.	I reflected about myself.	0 1 2 3 4
4.	I daydreamed about myself.	0 1 2 3 4
5.	I thought deeply about myself.	0 1 2 3 4
6.	I attended to my inner feelings.	0 1 2 3 4
7.	I examined my motives.	0 1 2 3 4
8.	I felt that I was off somewhere watching myself.	0 1 2 3 4
9.	I felt confident about my abilities.	0 1 2 3 4
10.	I was worried about whether I am regarded as a success or failure.	0 1 2 3 4
11.	I felt self-conscious.	0 1 2 3 4
12.	I felt as smart as others.	0 1 2 3 4
13.	I was worried about what other people think of me.	0 1 2 3 4
14.	I felt confident that I understood things.	0 1 2 3 4
15.	I felt inferior to others.	0 1 2 3 4
16.	I felt concerned about the impression I was making.	0 1 2 3 4
17.	I felt that I had less scholastic ability than others.	0 1 2 3 4
18.	I was worried about looking foolish.	0 1 2 3 4
19.	My attention was directed towards things other than the task.	0 1 2 3 4
20.	I found physical sensations such as muscular tension distracting.	0 1 2 3 4
21.	My performance was impaired by thoughts irrelevant to the task.	0 1 2 3 4
22.	I had too much to think about to be able to concentrate on the task.	0 1 2 3 4
23.	My thinking was generally clear and sharp.	0 1 2 3 4
24.	I found it hard to maintain my concentration for more than a short time.	0 1 2 3 4
25.	My mind wandered a great deal.	0 1 2 3 4
26.	My thoughts were confused and difficult to control	0 1 2 3 4
27.	I performed proficiently on this task.	0 1 2 3 4
28.	Generally, I felt in control of things.	0 1 2 3 4

4. THINKING CONTENT

This set of questions concerns the kinds of thoughts that go through people's heads at particular times, for example while they are doing some task or activity. Below is a list of thoughts, some of which you might have had recently. Please indicate roughly how often you had each thought during **THE LAST TEN MINUTES** (while performing the task), by circling a number from the list below.

1= Never 2= Once 3= A few times 4= Often 5= Very often

1.	I thought about how I should work more carefully.	1 2 3 4 5
2.	I thought about how much time I had left.	1 2 3 4 5
3.	I thought about how others have done on this task.	1 2 3 4 5
4.	I thought about the difficulty of the problems.	1 2 3 4 5
5.	I thought about my level of ability.	1 2 3 4 5
6.	I thought about the purpose of the experiment.	1 2 3 4 5
7.	I thought about how I would feel if I were told how I performed.	1 2 3 4 5
8.	I thought about how often I get confused.	1 2 3 4 5
9.	I thought about members of my family.	1 2 3 4 5
10.	I thought about something that made me feel guilty.	1 2 3 4 5
11.	I thought about personal worries.	1 2 3 4 5
12.	I thought about something that made me feel angry.	1 2 3 4 5
13.	I thought about something that happened earlier today.	1 2 3 4 5
14.	I thought about something that happened in the recent past (last few days, but not today).	1 2 3 4 5
15.	I thought about something that happened in the distant past	1 2 3 4 5
16.	I thought about something that might happen in the future.	1 2 3 4 5

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Appendix G. The Need for Cognitive Structure (NCS) Scale

Directions: Choose one rating for each statement.

(1) I feel better when everything is in its own place.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(2) People who appear to be uncertain about various things make me feel uneasy.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(3) It is unpleasant for me to enter a situation without knowing what to expect from it.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(4) I don't like to work on a problem that does not have a clear-cut solution.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(5) I prefer things to be predictable and certain.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(6) I always felt that there is a clear difference between what is right and what is wrong.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(7) I cannot enjoy a movie when I am unclear about the director's purpose.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(8) It irritates me to listen to someone who cannot make up his/her mind.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(9) I don't like to dwell on hypothetical situations.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(10) It annoys me when something unexpected disturbs my daily routine.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(11) I get very disturbed when forced to put aside an unfinished task.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(12) I feel uneasy when I am in the company of people whose behavior I can't understand.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(13) I feel more comfortable in a situation when the rules are clear and well defined.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(14) It bothers me when I doubt my beliefs.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(15) I don't like modern paintings in which I don't know what the painter meant.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(16) In order to prepare a good dish it is absolutely essential to follow the recipe exactly.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(17) I hate to change my plans at the last moment.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(18) I think every problem has a clear-cut solution.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(19) If I were a scientist, it would bother me that my work would never be completed (because in science new things come up all the time).

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(20) I can’t enjoy my life when I do not have a stable routine.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

INTENTIONALLY LEFT BLANK

Appendix H. The Ability to Achieve Cognitive Structure (AACS) Scale

Directions: Choose one rating for each statement.

(1) I tend to delay making important decisions until the last possible moment and even then I continue to be troubled by it.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(2) It takes me a long time before I commit myself to interpersonal relationships, because I can never be sure enough of the other persons attitude towards me.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(3) My work is usually carefully planned and well organized.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(4) I have no problem in meeting deadlines.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(5) Even if I make notes of things I have to do, it is hard for me to act upon them.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(6) I've always adopted a very structured way of life.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(7) I tend to hesitate when I have to make an important decision even after thinking a lot about it.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(8) Sometimes I am irritated by my hesitation to make a decision.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(9) I seldom doubt my own beliefs.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(10) Even after I have reached a decision, I continue to think about the pros and cons in order to make sure that I did not make a mistake.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(11) When I find myself involved in a decision, I often do not commit myself to any point of view in case I might be wrong.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(12) Usually, I don’t have second thoughts after making a decision.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(13) I find myself avoiding new experiences but I am not comfortable with sticking to the known and experienced.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(14) I frequently feel that time just melts away.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(15) Sometimes I hesitate to commit myself out of fear of making a mistake.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(16) It is easy for me to create a steady routine in my life.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(17) I often experience stress when I have to reach a clear-cut decision.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(18) Even if I finish my exam early, I stay until the end in case I change my mind.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(19) Even when I am bothered by a decision I should make, it is hard for me to make up my mind and free myself from the hassle.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(20) It is often hard for me to decide about relatively simple things, such as how to dress or what to order in a restaurant.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(21) Even in new situations I don't need many cues in order to decide what is the appropriate social behavior.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(22) I do not tend to 'dwell' on important decisions before making them.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(23) Sometimes it is difficult for me to decide between two possibilities with similar chances of success or failure.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

(24) Rarely do I put something somewhere and cannot find it later.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree

Appendix I. The Uncertainty Response Scale

Directions: Please rate each statement as it relates to you.

1. I tend to give up easily when I don't clearly understand a situation.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

2. When I go shopping, I like to have a list exactly of what I need.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

3. I feel better about myself when I know that I have done all I can to accurately plan my future.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

4. Sudden changes make me feel upset.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

5. When making a decision, I am deterred by the fear of making a mistake.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

6. When uncertain, I act very cautiously until I have more information about the situation.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

7. I like to have things under control.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

8. When the future is uncertain, I generally expect the worst to happen.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

9. Facing uncertainty is a nerve-wracking experience.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

10. I get worried when a situation is uncertain.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

11. Thinking about uncertainty makes me feel depressed.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

12. I find the prospect of change exciting and stimulating.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

13. Uncertainty frightens me.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

14. There is something exciting about being kept in suspense.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

15. The idea of taking a trip to a new country fascinates me.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

16. I like going on holidays with nothing planned in advance.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

17. I think you have to be flexible to work effectively.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

18. Taking chances is part of life.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

19. When I feel uncertain about something, I try to rationally weigh up all the information I have.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

20. Before making any changes, I need to think things over thoroughly.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

21. I prefer to stick to tried and tested ways of doing things.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

22. I like to have my weekends planned in advance.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

23. I feel curious about new experiences.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

24. I like to think of a new experience in terms of a challenge.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

25. A new experience is an occasion to learn something new.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

26. When I feel a situation is unclear, I try to do my best to resolve it.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

27. I like to know exactly what I'm going to do next.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

28. When facing an uncertain situation, I tend to prepare as much as possible, and then hope for the best.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

29. I feel relieved when an ambiguous situation suddenly becomes clear.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

30. When I feel uncertain, I try to take decisive steps to clarify the situation.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

31. When I can't clearly discern situations, I get apprehensive.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

32. I enjoy finding new ways of working out problems.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

33. When I'm not certain about someone's intentions towards me, I often become upset or angry.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

34. New experiences can be useful.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

35. When uncertain about what to do next, I tend to feel lost.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

36. I feel anxious when things are changing.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

37. New experiences excite me.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

38. I think variety is the spice of life.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

39. I try to have my life and career clearly mapped out.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

40. I think a mid-life career change is an exciting idea.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

41. When a situation is unclear, it makes me feel angry.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

42. I enjoy unexpected events.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

43. I like things to be ordered and in place, both at work and at home.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

44. I really get anxious if I don't know what someone thinks about me.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

45. I easily adapt to novelty.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

46. I am hesitant when it comes to making changes.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

47. I like to plan ahead in detail rather than leaving things to chance.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

48. Before I buy something, I have to view every sample I can find.

1	2	3	4	5
Never	Sometimes	Now and Then	Often	Always

Appendix J. Volunteer Agreement Affidavit

VOLUNTEER AGREEMENT AFFIDAVIT:
ARL-HRED Local Adaptation of DA Form 5303-R. For use of this form, see AR 70-25 or AR 40-38

The proponent for this research is:	**U.S. Army Research Laboratory** **Human Research and Engineering Directorate** **Aberdeen Proving Ground, MD 21005**

Authority:	Privacy Act of 1974, 10 USC 3013, 44 USC 3101, and 10 USC 1071-1087
Principal purpose:	To document voluntary participation in the Research program. Social Security number (SSN) and home address will be used for identification and locating purposes.
Routine Uses:	The SSN and home address will be used for identification and locating purposes. Information derived from the project will be used for documentation, adjudication of claims, and mandatory reporting of medical conditions as required by law. Information may be furnished to Federal, State, and local agencies.
Disclosure:	The furnishing of your SSN and home address is mandatory and necessary to provide identification and to contact you if future information indicates that your health may be adversely affected. Failure to provide the information may preclude your voluntary participation in this data collection.

Part A • Volunteer agreement affidavit for subjects in approved Department of Army research projects

Note: Volunteers are authorized medical care for any injury or disease that is the direct result of participating in this project (under the provisions of AR 40-38 and AR 70-25).

Title of Research Project:	An Initial Investigation of Factors Affecting Multi-task Performance	
Human Use Protocol Log Number:	ARL-20098-02007	
Principal Investigator(s):	Teresa A. Branscome U.S. Army Research Laboratory Soldier Performance Division Cognitive Sciences Branch	Phone: 410-278-5951 E-Mail: tbransco@arl.army.mil
Associate Investigator(s)		
Location of Research:	Aberdeen Proving Ground, MD	
Dates of Participation:	July 1 through December 31, 2004	

I do hereby volunteer to participate in the research project described in the table above. I have full capacity to consent and have attained my 18th birthday. The implications of my voluntary participation, duration, and purpose of the research project, the methods and means by which it is to be conducted, and the inconveniences and hazards that may reasonably be expected have been explained to me. I have been given an opportunity to ask questions concerning this research project. Any such questions were answered to my full and complete satisfaction. Should any further questions arise concerning my rights or project related injury, I may contact the **ARL-HRED Human Use Committee Chairperson at Aberdeen Proving Ground, Maryland, USA by telephone at 410-278-0612 or DSN 298-0612.** I understand that any published data will not reveal my identity. If I choose not to participate, or later wish to withdraw from any portion of it, I may do so without penalty. I understand that military personnel are not subject to punishment under the Uniform Code of Military Justice for choosing not to take part as human volunteers and that no administrative sanctions can be given me for choosing not to participate. I may at any time during the course of the project revoke my consent and withdraw without penalty or loss of benefits. However, I may be required (military volunteer) or requested (civilian volunteer) to undergo certain examinations if, in the opinion of an attending physician, such examinations are necessary for my health and well being.

Part B • To be completed by the Principal Investigator
Note: Instruction for elements of the informed consent provided as detailed explanation in accordance with Appendix C, AR 40-38 or AR 70-25.

Purpose of the Research

The purposes of this research are:

- To determine the effects of increased task load on multi-task performance and heart rate variability (HRV).
- To identify non-invasive psychological and physiological measures of cognitive readiness in a multi-task environment.
- To increase fundamental knowledge of individual factors affecting multi-task performance.

Procedures

If you agree to participate in this study, you will be asked to sign this Volunteer Agreement Affidavit. You will then complete a series of questionnaires. The demographics questionnaire requests information regarding age, gender, vision and hearing, military service and computer experience. The Multiple Affect Adjective Checklist contains a list of adjectives and you will be asked to check all the words that describe how you "generally" feel. The Zuckerman-Kuhlman Personality Questionnaire-Form III will be administered to identify different aspects of personality. The Polychronicity Scale will be used to determine the extent to which you prefer working on several tasks at once. You will complete the Situational Self-Efficacy Scale, in which you will be asked to rate (from 1 to 10) your level of confidence in your ability to do well. The Dundee Stress State Questionnaire (DSSQ) will be administered to assess stress relevant to performance testing contexts. One version of the DSSQ will be administered prior to task performance and the other will be administered after task performance. Lastly you will complete the Need for Cognitive Structure Scale, the Ability to Achieve Cognitive Structure Scale and the Uncertainty Response Scale' which will assess how you cope with uncertainty. These questionnaires are being used to better understand how personality characteristics impact on performance.

Heart rate will be collected using an ECG monitor. A bipolar configuration will be applied using three electrodes.

After receiving verbal instructions and a demonstration of each task, you will complete two five-minute training sessions in each condition followed by a five-minute break. You will then complete one 10-minute test trial in each condition with a mandatory five-minute break between each trial.

Benefits

You will receive the personal satisfaction of supporting Army cognitive sciences research.

Risks

The risks that will be encountered in this study are minimal and typical of the everyday risks encountered by military and civilian personnel performing office duties using their computers. The familiarization period and the test sessions will be conducted indoors.

If any problems occur during the study, please inform the investigators immediately. You may be told to stop your activity until the problems are resolved.

Confidentiality

All data and information obtained about you will be considered privileged and held in confidence. Photographic or video images of you taken during this data collection will not be identified with any of your personal information (name, rank, or status). All examinations will be recorded using a volunteer identifier code and a separate file with your consent form and the Principal Investigator will keep your assigned volunteer identifier code in a locked cabinet. Complete confidentiality cannot be promised, particularly if you are a military service member, because information bearing on your health may be required to be reported to appropriate medical or command authorities. In addition, applicable regulations note the possibility that the U.S. Army Medical Research and Materiel Command (MRMC-RCQ) officials may inspect the records. In order to ensure that your data will not be reported or revealed to anyone, each form will be reviewed upon receipt by one of the investigators. If any identifying information appears on the questionnaires (such as name, social security number, birth date, etc.), the investigators will delete the identifying information and replace it with a neutral code number

Disposition of Volunteer Agreement Affidavit

The Principal Investigator will retain the original signed Volunteer Agreement Affidavit and forward a photocopy of it to the Chair of the Human Use Committee after the data collection. The test administrator will provide a copy to the volunteer

Contacts for Additional Assistance

If you have questions concerning your rights on research-related injury, or if you have any complaints about your treatment while participating in this research, you can contact:

Chair, Human Use Committee
U.S. Army Research Laboratory
Human Research and Engineering Directorate
Aberdeen Proving Ground, MD 21005
(410) 278-0612 or (DSN) 298-0612

OR

Office of the Chief Counsel
U.S. Army Research Laboratory
2800 Powder Mill Road
Adelphi, MD 20783-1197
(301) 394-1070 or (DSN) 290-1070

Your signature below indicates that you: (1) are at least 18 years of age, (2) have read the information on this form, (3) have been given the opportunity to ask questions and they have been answered to your satisfaction, and (4) have decided to participate based on the information provided on this form.

Printed Name of Volunteer (First, MI., Last)	
Social Security Number (SSN)	***Permanent Address of Volunteer***
Date of Birth (Month, Day, Year)	
Today's Date (Month, Day, Year)	***Signature of Volunteer***
Signature of Administrator	

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8 July 2008

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: ARL-TR-4325, "An Investigation of Factors Affecting Multi-task Performance in an Immersive Environment," December 2007, by Teresa A. Branscome and Jock O. Grynovicki

Errata sheet attached (encl) for the above-listed report.

Encl

Teresa A Branscome
Teresa A. Branscome
MANPRINT Methods and Analysis Branch

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ERRATA SHEET

re: ARL-TR-4325, "An Investigation of Factors Affecting Multi-task Performance in an Immersive Environment," December 2007, by Teresa A. Branscome and Jock O. Grynovicki

Replace page 3 with new page 3 attached.

1. Reason: Tenth line of third paragraph has been corrected, and new sentence was added to the bottom of the page.

Change: decisions in uncertain situations (Cosenzo & Branscome, to be published). One objective of the present study is to further assess the utility of Bar-Tal's and Greco and Rogers' metrics for predicting performance in a multi-task environment.

To read: decisions in uncertain situations (Cosenzo, Fatkin, & Branscome, 2005). One objective of the present study is to further assess the utility of Bar-Tal's and Greco and Rogers' metrics for predicting performance in a multi-task environment.

2. Replace page 4 with new page 4 attached.

Reason: Sentence added to page 3 caused more text to wrap to page 4.

3. Replace page 14 with new page 14 attached.

Reason: The following reference has been corrected.

Change: Cosenzo, K.A.; Branscome, T.A. *Cognitive Uncertainty and Work Shifts in a Real-World Multi-task Environment*; U.S. Army Research Laboratory: Aberdeen Proving Ground, MD, to be published.

To read: Cosenzo, K.A.; Fatkin, L.T.; Branscome, T.A. *Cognitive Uncertainty and Work Shifts in a Real-World Multi-task Environment*; ARL-TR-3515; U.S. Army Research Laboratory: Aberdeen Proving Ground, MD, May 2005.

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